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1. **That was the year that was**
Anonymous. **GPS World Newsletter.** Eugene: Dec 22, 2000. Vol. 10, Iss. 25; p. 1 (3 pages)
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2. **ALL EYES SYSTEMS DESIGNED FOR SAFETY AND CONVENIENCE ARE RAISING QUESTIONS ABOUT PRIVACY; [Chicago Sports Final , N Edition]**
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5. **Canada NewsWire summary of releases for Evening, Friday, December 8, 2000**
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6. **Canada NewsWire summary of releases for Afternoon, Friday, December 8, 2000**
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13. **Caddy DeVille leads auto embrace of telematics; [Final Edition]**
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14. **Eyes on the road, hands on the wheel: The OnStar approach to in-vehicle communication and safety**
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15. **Geoworks Teams with U.S. Wireless Corp to Create New Location-Based Mobile Data Service Capability**
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17. **U.S. Wireless Corporation Reports Second Quarter Results**
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18. **U.S. Wireless Technology Cited by Nation's Largest Carriers As Potential Solution for Meeting Phase II of the FCC's E-911 Mandate**
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Mike Juha. **R. F. Design.** Overland Park: Nov 2000. Vol. 23, Iss. 11; p. 58 (3 pages)
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CUE to Deliver Real-Time Traffic Information for Net Interstate's CRM Telematics Applications

PR Newswire. New York: Nov 6, 2000. pg. 1

Companies: Cue Corp
Dateline: *California, Italy*
Publication title: PR Newswire. New York: Nov 6, 2000. pg. 1
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Text Word Count 591
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Abstract (Document Summary)

Net Interstate President and CEO Lawrence E. Williams said, "As one of the largest and most well-respected real-time providers of on- line traffic management information, CUE represents the perfect partner for Virtual Garage Wireless. By combining CUE's quality traffic management content with our other best-of-breed **telematics** content offerings, we look forward to helping automotive **telematics** service providers to deliver value-added in-vehicle Internet services that enable businesses and consumers to achieve personalized, permission-based 1:1 relationships of mutual benefit."

"We are pleased to partner with **Net Interstate**," said Gordon Kaiser, Chairman and Chief Executive Officer of CUE. "CUE will help **Net Interstate** leverage the emerging **telematics** market to help the automotive industry to develop personalized in-vehicle interactions, dialogues between consumers and businesses, to create mutually beneficial economic relationships. We are fortunate to partner with **telematics** content leaders like **Net Interstate**."

Full Text (591 words)

TURIN, Italy, Nov. 6 /PRNewswire/ -- CUE Corporation announced today a strategic agreement under which CUE will provide real-time, route specific traffic information to **Net Interstate's** Customer Relationship Management (iCRM) **telematics** application called Virtual Garage Wireless(TM).

CUE Corporation, http://www.cue.net is the leading provider of real-time route-specific traffic information for over 60 markets in Canada and the United States in the RDS/TMC format and **Net Interstate**, http://www.NetInterstate.com, is a market leading developer of Internet relationship management software for the automotive industry.

Net Interstate President and CEO Lawrence E. Williams said, "As one of the largest and most well-respected real-

time providers of on- line traffic management information, CUE represents the perfect partner for Virtual Garage Wireless. By combining CUE's quality traffic management content with our other best-of-breed **telematics** content offerings, we look forward to helping automotive **telematics** service providers to deliver value-added in-vehicle Internet services that enable businesses and consumers to achieve personalized, permission-based 1:1 relationships of mutual benefit."

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About CUE:

CUE operates the world's largest radio data network providing nationwide, regional, and local messaging throughout North America over the FM subcarrier facilities of more than 600 radio stations. The company's network covers more than 95% of the population of Canada and the United States with a seamless footprint of more than 2 million square miles. CUE also provides real-time, route-specific traffic information in over 60 markets in Canada and the United States. Navigation systems using the CUE service include ⓘClarion, InfoGation, ⓘMotorola, ⓘSTMicroelectronics, and BMW. CUE has also developed receivers for two hand-held PDA's, the Handspring Visor and the Sectra CitySurfer.

Recently CUE introduced a voice version of its traffic service that compresses the RDS/TMC data into wave files and transmits it over a high-speed subcarrier channel to a receiver that connects to most car radios through the cellular telephone interface. The new TrafficRadio Service currently interfaces with ⓘFord, BMW, Pioneer, Alpine, ⓘSony and Becker radios.

Recently, CUE entered into an agreement with Tegaron in Germany and MediaMobile in France to distribute real time traffic information in Canada, the United States, France, Germany and England using common encryption and conditional access technology. Tegaron GmbH is a joint venture of ⓘDeutsche Telekom and DaimlerChrysler. MediaMobile is a joint venture between ⓘFrance Telecom, ⓘRenault, Traffic Master, and Cofiroute. Recently CUE announced that it will launch a traffic service in the United Kingdom in association with the Automobile Association.

About **Net Interstate**:

Founded in January 1999, **Net Interstate** leverages the potential of the emerging **telematics** market to evolve the retail automotive experience by enabling consumers and automotive-centric businesses to achieve personalized, permission-based 1:1 relationships of mutual benefit. Through its robust Infomediary Customer Relationship Management (iCRM) **telematics** applications, **Net Interstate** enables automotive manufacturers, retail dealerships and other automotive- centric businesses to use the Internet to create highly targeted marketing and customer care programs that cater to their customers' specific interests and preferences.

CUE Corporation, 5 Corporate Park, Irvine, California, 92606; Phone (949) 862-8800; Fax (949) 862-8858; www.cue.net. Contact: Mary Boyle, mboyle@cue.net.

Net Interstate, 22912 Pacific Park Drive, Suite 202, Aliso Viejo, California 92656; Phone (949) 362-8989; Fax (949) 362-3567; www.NetInterstate.com; Contact Thomas Nashmy, info@NetInterstate.com. SOURCE CUE Corporation

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Clifford enters telematics with net-based car PC

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Abstract (Document Summary)

Clifford Electronics recently entered the **telematics** market, with two new products, including an Internet-based car computer. Called InfoTrack 1, the car computer is essentially a 486 "network PC" black box with GPS and modem that is designed to hook up to a Windows CE PDA.

Full Text (558 words)

Clifford Electronics entered the **telematics** market at CES, with two new products, including an Internet-based car computer.

Called InfoTrack 1, the car computer is essentially a 486 "network PC" black box with GPS and modem that is designed to hook up to a Windows CE PDA. (A PalmPilot interface will be available shortly.) It provides real-time turn-by-turn navigation, e-mail and fax, and dynamic concierge services, the company said.

The InfoTrack 1 automatically recognizes the PDA when connected and can also be hooked into the car electronics to perform automatic car diagnostics and maintenance alerts.

All InfoTrack functions are performed in real time to allow automatic monitoring of the car functions.The system can immediately notify a participating local automotive service center of problems for either remote diagnostics or to

schedule a repair appointment.

InfoTrack 1 also performs real-time turn-by-turn map and voice-driven navigation, so drivers are "dynamically rerouted" if they make a wrong turn.

Other capabilities of InfoTrack 1 include e-mail send and receive, and fax-out, as well as real-time traffic monitoring, concierge services and roadside assistance. (The system can be preset to call AAA in an **emergency**.)

InfoTrack 1 is expected to be linked to stores and services so that, when combined with the GPS locator, it can send "reminders" to drivers as they pass a particular store. (If the user passes McDonald's at noon, it might suggest he or she go there for lunch - and offer a coupon special.) The system will come with an optional text-to-speech voice module for safe operation while driving.

InfoMove, Seattle, hosts the server and provides the software for the system. An ISP for the system will be announced. The suggested retail price is expected to fall in the $600-$650 range, with availability slated for the fourth quarter.

Clifford's sales and marketing VP Tom Mitchell, in announcing the new products, said, "We're committed to **telematics**. We see it as a natural extension of our security business and a direction for the future of our company."

"No one has done anything like this," he added. "Other systems use live operators. We are set up so that the software takes GPS information and compares it to our server information and delivers voice-to-text information in response."

The basic unit unveiled by Clifford is a **telematics** product called the MobileTrace 1. It is essentially a black box with built-in GPS and modem to allow advanced vehicle location and **emergency** assistance.

The MobileTrace 1 has a panic button that is monitored 24 hours a day, seven days a week by a live call center run by start-up service provider Televoke, San Francisco.

The call center also has a user profile of the driver, "so if you have a heart condition, we'll not only notify **police** but your hospital and doctor as well," said Mitchell.

MobileTrace 1 also provides vehicle location and offers many user options for convenience or security alerts (when it is combined with a Clifford security system). Users can preset the system (via an Internet website) to call their cellphone, home or office for specific security breaches (as an example, if the door sensor is triggered, it can call a cellphone).

The MobileTrace 1 is expected to ship at the end of the second quarter at a suggested retail price of $500. The Televoke service will carry a basic fee of $9.95 per month.*

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Improving Police 911 Operations in Washington, D.C.
Patricia Kuhn; Thomas P Hoey
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Improving Police 911 Operations in Washington, D.C.

A three-part program for improving emergency 911 performance in the District of Columbia has produced dramatic results.

Patricia Kuhn and Thomas P. Hoey

Washington, D.C.'s 911 operation generated an increasing number of complaints from city officials and residents alike in recent years. Call-handling performance was unacceptable: 33 percent of the calls were kept waiting and 17 percent were abandoned for lack of response. Operations were constrained by aged 911 hardware and software, a crude call distributor, and the lack of reliable data to manage an operation that has the highest call volume in the Washington metropolitan area. Other symptoms of operational problems included inefficient dispatching practices, perceived manpower shortages, pay inequity, and poor employee morale.

Early in 1986 D.C. Mayor Marion Barry and Police Chief Maurice Turner, Jr., launched two initiatives to improve 911 operations: the application of new technology, in the form of Enhanced 911, and an operations improvement project. The E-911 system was designed to replace antiquated telephone and call distribution equipment with state-of-the-art systems. The operations improvement project focused on three issues: (1) matching staff deployment with call demand; (2) improving call-handling performance; and (3) improving civilian pay equity.

This article focuses on the operations analysis and implementation phases of the project. The operations analysis phase was quite extensive and included a variety of traditional operations research techniques as well as computer applications. The methodology used in the project has general applicability for other twenty-four-hour-a-day, seven-day-a-week service-driven operations, particularly those that are experiencing performance problems or are considering technology upgrades.

911 systems overview

Prior to 1968, localities throughout the United States used standard seven-digit telephone numbers

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In recent years, the MPD's call-handling performance was a source of consternation.

for callers who required emergency services. It was not uncommon for a community to have at least three separate emergency numbers: one each for police, fire, and emergency medical service. In metropolitan areas containing townships, cities, and counties, there could be as many as 100 seven-digit phone numbers for reporting emergencies, as was the case in the Twin Cities area (Minneapolis-St. Paul, Minnesota). Many jurisdictions continue to operate with decentralized, multiple service, seven-digit telephone systems.

The concept of a three-digit, "universal" emergency number was developed to eliminate confusion over which telephone number to call and to improve upon response time in emergencies. Since its introduction by AT&T eighteeen years ago, 911 service has been widely accepted and implemented by over 1,000 localities in the U.S. Communities that utilize 911 agree to designate one agency as the "Public Safety Answering Point" (PSAP) for the entire locality. Calls are automatically directed to the PSAP on dedicated trunk lines. A 911 system has clear advantages over decentralized seven-digit telephone systems. The advantages of 911 are that it:

- Is easy to remember, easy to dial, and minimizes dialing time;
- Is the only number one need call for any emergency in a community using a 911 system; and
- Will ultimately be the standard emergency phone number in all areas of the U.S.

Enhanced 911 (E-911) is an improved version of 911 service that was first developed in 1978. E-911 uses more sophisticated computer technology and offers some critical enhancements to the basic 911 system. The two foremost features are known as "ANI" and "ALI." ANI is an automatic number identification that displays the caller's telephone number on the operator's display panel. ALI is an automatic location identification that displays the caller's exact street address on the operator's screen. With ANI and ALI, the emergency operator can contact the caller to confirm the situation or location and can dispatch an emergency vehicle if the situation so warrants. When E-911 is coupled with an advanced-model, microcomputer-based automatic call distributor, the system is augmented by features such as queue displays, detailed statistical data, and advanced operator/supervisor panels.

D.C.'s 911 operation

The Metropolitan Police Department (MPD) is the PSAP for the District of Columbia. With the highest call volume in the D.C. metropolitan area, the MPD logs in over 2 million calls per year for police, fire, ambulance, and other services. Half of these calls are received on the 911 telephone lines and the other half are received on seven-digit lines designated for nonemergency calls. While the community is encouraged to dial the appropriate telephone number, neither the 911 or seven-digit lines are mutually exclusive.

Approximately 6,000 calls are received each day, with the highest volume occurring between 3 P.M. and 11 P.M.. The busiest days of the week are Friday and Saturday. Calls vary in length from about ten seconds to eighteen minutes, depending on the nature of the call and composure of the caller. The MPD's Communications Division's Operations Branch is staffed by 126 uniformed and civilian employees. They all carry the title "Police Communications Operator" but are functionally divided into telephone receipt clerks (TRCs) and radio dispatchers. Sixteen supervisors are assigned to the branch.

In recent years, the MPD's call-handling performance was a source of consternation for both city officials and the community alike. Operations were constrained by an aged 911 system, a very crude call distributor, and insufficient data for analyzing performance and determining corrective actions. Whenever call demands exceeded operator availability, a loud and persistent alarm sounded. Supervisors had no idea how many calls were waiting, whether they were 911 or nonemergency calls, or how long they had been waiting. The "call distribution" equipment, which consisted simply of a call-director type, multiline phoneset at each operator's position, also impeded service delivery. Operators could easily depress any flashing button without regard to which calls came in first.

The MPD had serious difficulty answering all calls and doing so promptly, as shown in Figure 1. In

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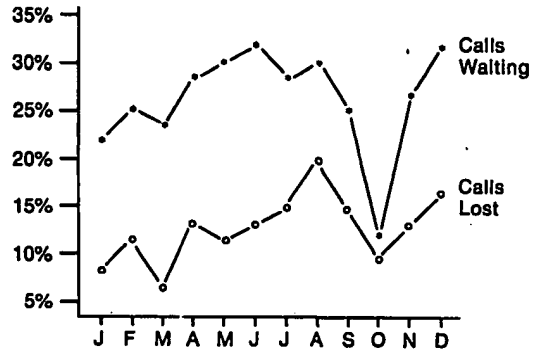
Figure 1
Call-Handling Performance, 1985



1985, one out of every six calls was abandoned by the caller, presumably because there was no response. In addition, one out of every three calls was kept waiting for periods of time usually ranging from about twenty seconds to three minutes before being answered.

Along with these call-processing difficulties, the division experienced problems dispatching calls for service. Under optimum circumstances, nine radio channels are used to provide service to seven police districts. the special operations unit, and the citywide unit. With this configuration, each police unit is afforded its own radio channel and dispatcher. Such dedicated service is intended to ensure that the population of mobile units serviced by each dispatcher is confined to a predetermined area of the city. If there are not enough dispatchers, it is necessary for two or more police units to "double up" and share one radio channel operated by one dispatcher. Whenever this occurs, up to 100 mobile units and one dispatcher must literally compete for "air time" to transmit information. The resulting increases in activity and voice transmissions hamper dispatch efficiency and create additional duress for the dispatcher and police officers alike.

An additional matter requiring attention was employee morale and civilian pay equity. MPD civilians earned considerably less than uniformed personnel in the MPD Communications Division and less than their civilian counterparts in the D.C. Fire Department and in other local jurisdictions.

Improvement initiatives

D.C. Mayor Marion Barry and Police Chief Maurice Turner, Jr., launched two initiatives designed to improve 911 operations: the design and installation of an Enhanced 911 system and a comprehensive operations analysis of the Communications Division. The E-911 system was designed to replace antiquated telephone and call distribution equipment with state-of-the-art equipment and to provide performance data that the MPD never had access to before. The operations analysis project was initiated in January 1986 as a joint effort of the MPD and the City Administrator's productivity staff. Project objectives were to: (1) ensure that staff deployment matches call demands; (2) reduce calls waiting and abandoned calls; and (3) improve civilian pay equity.

E-911

The E-911 implementation was completed on April 30, 1986. Four benefits are associated with this system:

- The physical location and phone number for the calling party are displayed on the operator's screen for each 911 call. Prior to E-911, the voice of the caller was the only "identifier" available to the MPD. E-911 eliminates the crises caused by prematurely terminated calls and those instances where the caller is lost, confused, or panic-stricken and cannot identify the location or exact address from which he or she is calling. With E-911, the telephone number and location of a lost child—or an individual making a bomb threat—are known immediately.
- The automatic call distributor (ACD)—which is the central processor of the E-911 system—is a highly efficient, state-of-the-art model, and has become the industry standard.
- The management information system generates hourly and on-demand data on calls received,

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The operations analysis completed in July 1986 was an innovative and highly successful endeavor.

average call duration, number of calls waiting, average waiting time, TRC productivity, etc. This data allows operations managers to optimize the number and configuration of TRCs and call distribution assignments.

- Antiquated call director phonesets have been replaced with operator instruments designed for speed, versatility, and ease of use.

Operations analysis

The operations analysis completed in July 1986 was an innovative and highly successful endeavor. First, it was the most comprehensive operations analysis of a communications operation ever undertaken in the Washington, D.C., metropolitan area. Second, a wide variety of both traditional operations analysis techniques and mainframe/microcomputer applications were used to solve the existing problems.

The sequencing and interrelationship of the project methodologies of the operations analysis were planned at the outset of the project. Activities fell into three stages:

1. Data collection and work measurement;
2. Use of quantitative models and software packages to experiment with data analysis simulation; and
3. Formulation of recommendations.

Figure 2 depicts these three stages of the operations analysis project used for the 911 project. The left-hand column of activities relates to data collection, the center column pertains to the use of analytical models, and the right-hand column consists of the results or recommendations.

Project methodologies included: development of a call demand data base; time study; work sampling; use of queuing, simulation, linear, and integer programming models; fixed bracket work schedule design; and a pay comparability study. And finally, the project team was able to improve upon an existing technology—a state-of-the-art Automatic Call Distributor—through the analytical techniques employed. Each technique is described below:

Pay comparability study. Eleven communications operations in the Washington, D.C., metropolitan area were surveyed. Of these, three entities were within District government, one was the local metro transit authority, and seven were operations in surrounding jurisdictions. For each entity, information was collected on pay scales, career ladders, entry level qualifications, staffing patterns, and call volumes. The data collected were used to assemble exhibits on pay comparability, work loads, and staffing patterns for the eleven entities; and the average salary for the metropolitan Washington, D.C., area.

Employee morale survey. A three-page, fourteen-question survey was developed and administered to Operations Branch employees. Questions pertained to job satisfaction, supervision, training, and the work environment. Eighty-six percent of the employees participated. Most of the questions required a scaled rating response and some required a handwritten, narrative-type response. Survey responses were summarized by shift and for the branch as a whole. The results were discussed with division managers and posted for employees to see.

Data-base development. Handwritten daily telephone statistical reports for calendar year 1985 were used as the source document for call demands.

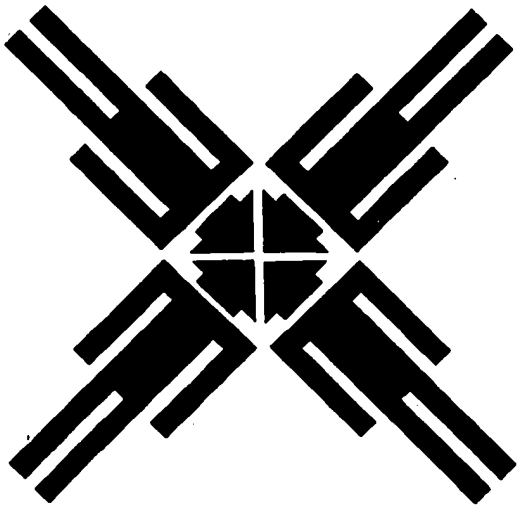
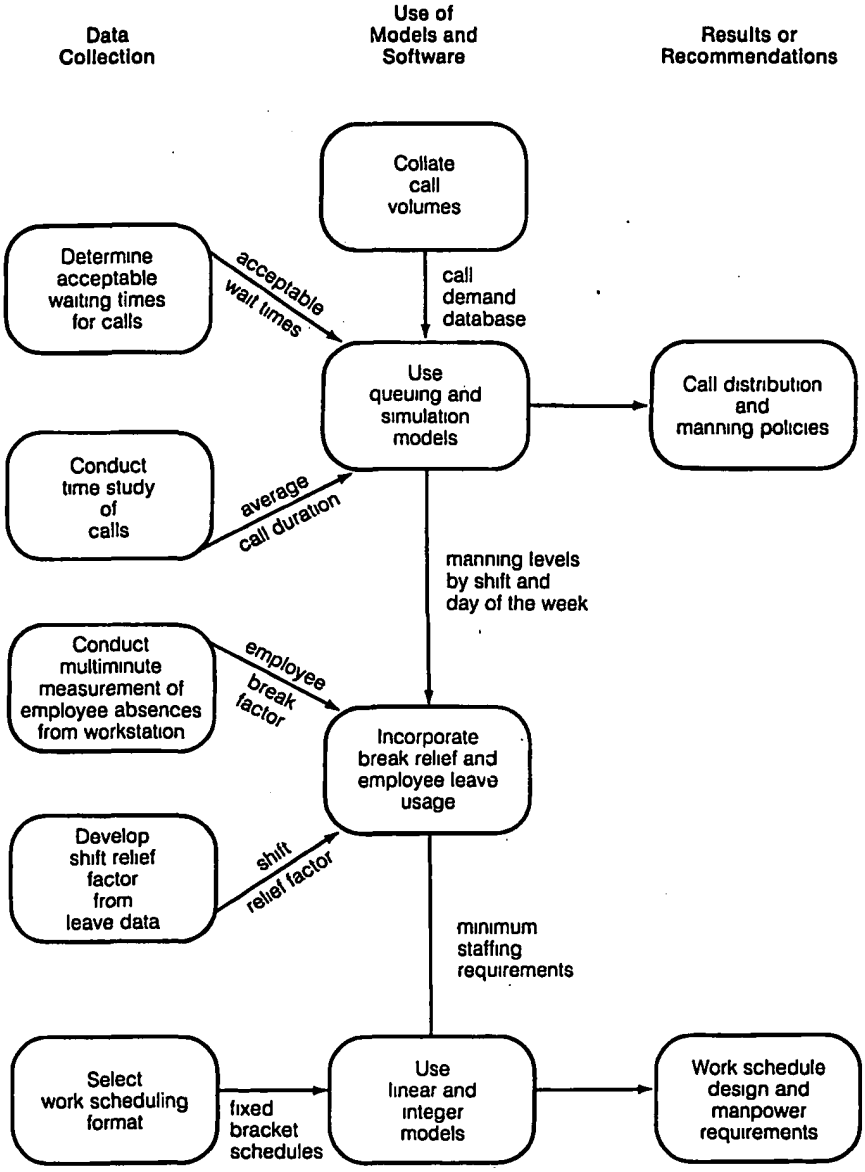


Figure 2
The Interplay of Project Methodologies of the Operations Analysis



To determine the total numbers of employees required, a shift relief factor was developed.

Data on calls received, calls waiting, and calls abandoned for six time frames during each twenty-four-hour period were entered into a microcomputer. Relational data-base software was selected for data entry, and a spreadsheet program was used for indexing and summarizing the call demand data base by shift, day of the week, month, holiday, and season.

Time study. Average call durations were measured in two phases using the stopwatch method. Call processing time data was obtained: (1) from a stratified random sample of taped recordings of calls received during 1985, and (2) from live calls that came in during the project time frame. For the first set of measurements, a random number table was used to select the dates, shifts, and TRC position numbers to be studied from the tapes. Call durations were measured, recorded, and analyzed using the mean, standard deviation and intervals at 95 percent confidence levels. For the second set of measurements, live calls were sampled from the three shifts and the seven days of the week.

Work measurement. Measurements of activity in the telephone receipt room were taken at three-minute intervals for eight shifts over a two-week period for the purpose of recording: (1) the amount of productive time for TRCs, (2) the amount of "wait time" or unavoidable delay between calls, and (3) the amount of time that call handlers were away from their work stations. These data were summarized by shift and for the branch as a whole.

Work schedule design. Call demand patterns varied widely by shift and day of the week, which indicated the need for customized schedules that are work-load-based. Several scheduling alternatives were examined, including: ten-hour, four-day work schedules; eight-hour, five-day work schedules; rotating duty hours and days off; and "power shifts," which augment coverage during peak call periods. The fixed bracket, eight-hour, five-day work schedule was found to be the most appropriate and the most versatile for several reasons: (1) it allows specifically tailored deployment to varying work loads throughout the twenty-one shifts per week, (2) it contains provisions for relief personnel on a per shift and annual basis, and (3) it satisfies MDP conventions providing for employee "squads" to have two permanent, consecutive days off each week. Manual calculations of minimum staffing levels for each shift and day of the week were developed. The resulting work schedules were then verified with the use of linear and integer programs run on a mainframe computer at a local university.

Shift relief factor. To determine the total number of employees required to staff the positions on each tour of duty and on an annual basis, a shift relief factor was developed. This takes into account the size of the work force and the actual amount of leave taken during the year to arrive at the remaining number of staff days available for scheduling. The leave taken by Operations Branch employees was high due to their length of service and high rate of leave accrual. This resulted in fewer equivalent full-time personnel being available to staff the operations.

Queuing model. An M/M/C queuing model—a basic queuing model with assumptions and characteristics applicable to the needs of the analysis—was used to predict the average call waiting times as a function of call distribution policies and the number of call handlers working. Two call-handling policies were compared: (1) the existing method of "dedicated" ACD software that restricts call handlers to answering either 911 or nonemergency calls, and (2) the method of "pooling" ACD software, which merges the call handlers into one group that accepts both types of calls. The latter method was chosen.

Simulation model. A digital simulation language was used to simulate, or statistically recreate, an entire shift. Incoming calls were generated, queued, and distributed to call handlers. Call-handling times were then calculated and statistics were collected on the percentage of calls waiting, average waiting times, and abandoned call rates. The simulation model was verified and used to test the effects of different versions of the call distributor software on call-handling performance.

Linear and integer models. Linear programming was used to determine minimum shift staffing levels needed to meet call demands with acceptable (low) waiting times. Each shift's minimum requirement in terms of number of employees was taken into account along with the shift relief factor. Whenever fractional numbers of employees resulted, such as 7.41 employees, an integer program model was used to solve the scheduling problem.

Study findings

Major findings of the evaluation were:

- No additional employees were needed, provided that work schedules were adjusted;
- Employee work schedules bore no relationship to work loads;
- Poorly designed work schedules were responsible for the inability to dispatch on separate radio channels;
- The Automatic Call Distributor (ACD) software was inefficient, causing calls to wait in queue when there were call handlers available;
- Supervision was inadequate;
- The average call handler was away from his or her work station for 2.24 hours in each shift;
- Call waiting times jumped dramatically when employees left their work stations; and
- Civilian operators earned 25 percent less than the average pay scale in eleven local jurisdictions.

Two of the above findings were major factors in poor call handling performance—excessive employee absences from their work stations and failure to maintain constant staffing levels in the call handling room through availability of relief or back-up personnel. As shown in Table 1, call waiting times are extremely sensitive to staffing levels. On the particular shift depicted in the table, 3 P.M. to 11 P.M. on a Saturday, ten TRCs were present. When six employees were answering 911 calls and four employees were answering nonemergency calls, the average waiting times were quite low. But whenever an employee left his or her work station, thereby reducing the staffing level, call waiting times escalated sharply. This sensitivity is best illustrated by observing that when two call handlers left the room, waiting times for nonemergency calls jumped from 1.6 seconds to 64.0 seconds. Similarly, waiting time for 911 calls jumped from 2.2 seconds to 34.0 seconds when staffing levels dropped from six employees to four.

Table 1
Sensitivity of Call Waiting Time to Staffing Levels

911 Calls (1,047)	Nonemergency Calls (551)
6 TRCs* = 2 2 seconds	4 TRCs* = 1.6 seconds
5 TRCs* = 7 8 seconds	3 TRCs* = 8.6 seconds
4 TRCs* = 34 0 seconds	2 TRCs* = 64.0 seconds

* TRCs = telephone receipt clerks

Recommendations

Opportunities for improvement were identified in the areas of technology application and human-resource management. Recommendations made to MPD management included:

1. Modifying call distributor software to increase efficiency in call processing;
2. Implementing revised work schedules for employees and supervisors;
3. Introducing a work-station coverage policy to assure constant manning throughout each shift;
4. Increasing supervisors by five to provide fixed post and mobile supervision on each shift; and
5. Upgrading employee career ladders and increasing civilian salaries by 25 percent.

The first, second, and third recommendations were cost free and have yielded the most dramatic improvements thus far. The fourth recommendation, to increase the number of supervisors by five, was accepted by MPD managers and is in the process of being implemented. However, adding new positions requires a series of financial, budgetary, and managerial approvals. The fifth recommendation, to upgrade pay scales for civilian employees and supervisors, was implemented in July 1986 at a first-year cost of roughly $74,000. Performance benefits as a result of this action are impossible to quantify; however, there are obvious benefits in terms of employee morale, recruitment, and retention.

The work-load-based employee schedules developed by the project team had major implications in terms of improving deployment with the existing number of staff. As an example, the proposed work

Deployment would be based on service demand patterns instead of employee tenure or preference.

Figure 3
Revised Work Schedule for 11 PM to 7 AM Shift

MIDNIGHT SHIFT — 35 EMPLOYEES

PROPOSED WORK SCHEDULES (11:00 PM–7:00 AM)								
Squad	Employees	Sun	Mon	Tues	Wed	Thur	Fri	Sat
Squad 1	(5)	DO	DO	5	5	5	5	5
Squad 2	(5)	5	DO	DO	5	5	5	5
Squad 3	(6)	6	6	DO	DO	6	6	6
Squad 4	(5)	5	5	5	DO	DO	5	5
Squad 5	(6)	6	6	6	6	DO	DO	6
Squad 6	(5)	5	5	5	5	5	DO	DO
Squad 7	(3)	DO	3	3	3	3	3	DO
Scheduled on duty		27	25	24	24	24	24	27
Minimum required		20	19	19	19	19	19	20

How to Use This Work Schedule
- Thirty-five (35) employees should be assigned to the midnight shift
- The number of employees to be allocated to each squad is shown in parentheses next to each squad For example, five employees are in squad one, and their days off (DO) are Sunday and Monday each week
- Looking at Monday's column in the schedule, the total number of employees scheduled for this shift is 25 Based on historical leave usage, if 25 are scheduled, on average, 19 will appear for work And for this particular shift, 19 employees is the minimum required staffing level

schedule for the midnight shift (11 P.M. to 7 A.M.) is shown in Figure 3. The revised work schedules offered numerous advantages over the existing schedules. The key benefits were:

- Deployment would be based on service demand patterns instead of employee tenure or preference;
- Erratic call-handling performance, which had been caused by overstaffing in midweek and understaffing on weekends, would be eliminated;
- Optimum staffing of employees on each shift and day of the week would permit dispatching on separate radio channels for each police unit;
- Constant manning levels on each shift would be assured through the use of "relief" personnel to cover employee breaks and absences; and
- Supervisor and employee work schedule integrity would be improved by assuring that supervisory schedules are identical to those of the employees whom they supervise.

Results and conclusions

The three-step program employed by the District government entailed: (1) implementing E-911, (2) conducting a thorough operations analysis, and (3) implementing the recommendations that resulted from the analysis. Implementation brought about many improvements. As of October 31, 1986, the gains pertaining to call-handling performance were:

- 83 percent reduction in waiting time for nonemergency calls (from 40 seconds to 6.8 seconds);

- 68 percent reduction in waiting time for 911 calls (from 10 seconds to 3.2 seconds);
- 64 percent decrease in the number of calls waiting (from 33 percent to 12 percent); and
- 3 percent reduction in abandoned calls.

Since the principal objective of the project was to assist the MPD in getting the phones answered quickly and consistently, these call-handling performance improvements were the primary benefits. Other benefits that resulted from the project included: (1) a pay upgrade for civilian employees and supervisors, (2) a detailed summary of employee responses to the morale survey, and (3) increased management awareness of subtle operating problems in the division, such as inadequate direct supervision of employees, nonstandard call-taking procedures, and excessive employee absences from work stations.

A number of lessons were learned through this project. Although the project utilized state-of-the-art technology and sophisticated analytical techniques, in the final analysis the human element was the most important variable in the improvement process. Good supervision and resource management judgments are essential if targeted performance levels are to be maintained. Moreover, the importance of work-load-based employee schedules cannot be overemphasized. Poorly designed work schedules tend to drive labor costs up, have an adverse effect on service quality, and diminish employee morale.

RESOURCES

For further information on the program discussed in this article, contact Patricia Kuhn, Project Manager, Productivity Management Services, 1350 Pennsylvania Avenue NW #406, Washington, DC. Phone: 202-727-9251.

Patricia Kuhn is a senior project manager in the Productivity Management Services unit of the District of Columbia government. Her areas of expertise are organizational and staffing analysis, work simplification, and productivity improvement. The 911 improvement project, which she managed, received a Special Mention technology award from Public Technology, Inc., in 1986. She would like to acknowledge here the assistance of her colleagues on the project, Verdova Bishop and Raj Nagaraj.

Thomas P. Hoey is director of the Productivity Management Services unit. He is responsible for helping the District's agencies improve the efficiency and effectiveness of their services. Previously, he was involved in innovative financial management improvement projects for the governments of both the District of Columbia and the State of New York.